

NASA TM-76974

NASA-TM-76974 19840007180

NASA TECHNICAL MEMORANDUM

NASA TM-76974

TRICHITE GROWTH DURING OXIDATION OF TITANIUM
AND TA6V4 ALLOY BY WATER VAPOR AT HIGH TEMPERATURES

Christian Coddet, Francoise Motte,
Pierre Sarrasin

Translation of "Sur la croissance de trichites au
cours de l'oxydation du titane et de l'alliage
TA6V4 par la vapeur d'eau a haute temperature."
Academie des Sciences (Paris), Comptes Rendus,
Serie C - Sciences Chimiques, Vol. 281, No. 13, Sept. 29,
1975, p. 507-510

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. 20546 AUGUST 1982



NF00284

EDITION 6000

SEP 2 1982

LANGLEY RESEARCH CENTER
LIBRARY, NASA
HAMPTON, VIRGINIA

STANDARD TITLE PAGE

1. Report No. NASA TM-76974	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle TRICHITE GROWTH DURING OXIDATION OF TITANIUM AND TA6V4 ALLOY BY WATER VAPOR AT HIGH TEMPERATURE		5. Report Date AUGUST 1982	
7. Author(s) Christian Coddet, Francoise Motte, Pierre Sarrazin		6. Performing Organization Code	
9. Performing Organization Name and Address SCITRAN Box 5456 Santa Barbara, CA 93108		8. Performing Organization Report No.	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		10. Work Unit No.	
		11. Contract or Grant No. NASW- 3542	
		13. Type of Report and Period Covered Translation	
		14. Sponsoring Agency Code	
15. Supplementary Notes Translation of "Sur la croissance de trichites au cours de l'oxydation du titane et de l'alliage TA6V4 par la vapeur d'eau a haute temperature." Academie des Sciences (Paris), Comptes Rendus, Serie C- Sciences Chimiques, Vol. 281, No. 13, Sept. 29, 1975, p. 507-510 (A76-11974)			
16. Abstract The formation of rutile at the surface of the samples is noted during the oxidation of titanium and of the titanium alloy TA6V4 using water vapor at a high temperature. The formation of trichites at the surface of the oxidized samples is noted. The observations described are the subject of morphologic and crystallographic studies.			
17. Key Words (Selected by Author(s))		18. Distribution Statement Unclassified - Unlimited	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 4	22. Price

A76-11974 (ORIGIN)
N84-15248#
N-153,296

METALLOGRAPHY - On the growth of trichites during the oxydation of titanium and of the TA6V4 alloy by means of water vapor at a high temperature. Note (*) by Mr. Christian Coddet, Miss Françoise Motte and Mr. Pierre Sarrazin, presented by Mr. Georges Chaudron.

During the oxydation of titanium and of the titanium alloy TA6V4 using /507* water vapor at high temperature (650-950°C), we have observed, through electronic scan microscopy, the formation of rutile (titanium dioxide) at the surface of the samples. The morphology of these trichites depends mainly on the temperature and the nature of the sample (pure metal or alloy).

The oxydation of titanium and of titanium-based alloys through the use of water vapor does not seem, up to this day, to have been the subject of in-depth studies with the exception of the concise work by Lutschkin and Iljin ⁽¹⁾ and by Löhberg and Schleicher ⁽²⁾.

The work reported on here bears mainly on the oxydation of titanium and of the TA6V4 alloy at temperatures included between 650 and 950°C and at water vapor (steam) pressures between 0.5 and 18 Torr.

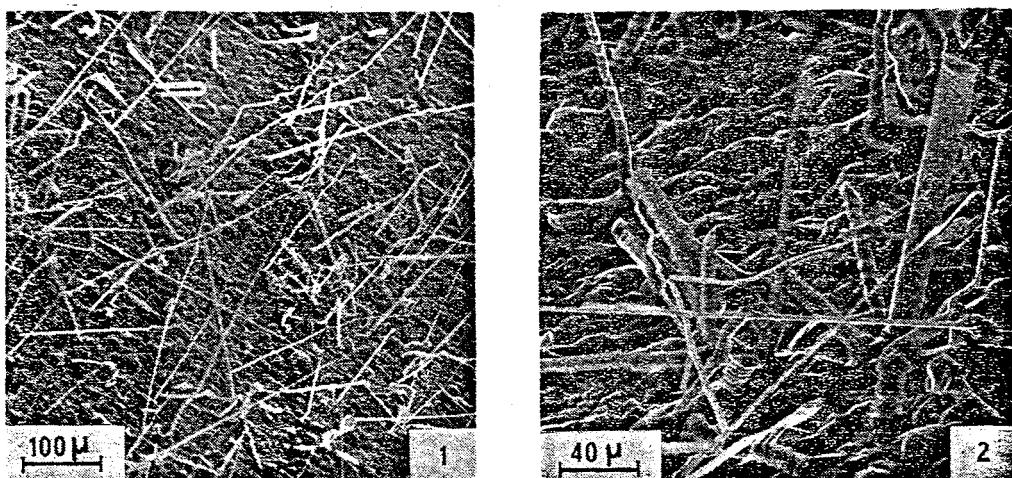


Figure 1 - Sample of Titanium oxydized at 700°C for 100 hours, $P_{H_2O} = 0.747$ Torr.

Figure 2 - Sample of Titanium oxydized at 750°C for 100 hours, $P_{H_2O} = 1.632$ Torr.

The samples used are made-up of small plates with an area close to 5 cm^2 .

*Numbers in margin indicate foreign pagination.

These samples are polished on silicon carbide paper up to 600 grain size, then cleaned to remove the oil by using acetone before being introduced in the enclosure used for the reaction. The steam pressure inside this enclosure was controlled by a thermostatically-controlled cold wall. Regardless of the nature of the oxydized sample (titanium or sample), two distinct sub-layers of rutile could be revealed ⁽³⁾: one outer sub-layer with a basaltic appearance and a microcrystalline inner sub-layer.

Therefore, if our study confirms the first recorded results relative to the rutile structure of the oxyde [(¹), (²)], it has also enabled us to show through observation by means of an electronic scan microscope, the formation of trichites at the surface of the oxydized samples. /508 The structure of these trichites as determined through X-ray analysis is of the rutile type; their morphology depends mostly on temperature; it does not seem to be significantly affected by the steam pressure.

Their overall appearance is also very different depending on whether they grow on pure titanium or on the TA6V4 alloy.

On pure titanium, and up to 700°C, the surface is covered with many very fine hairs (Figure 1). When the temperature rises, the number of trichites increases; it becomes nil above 850°C. At the same time, the average diameter of these trichites increases. Their shapes are very varied as well as their dimensions (Figures 2 through 6). We can measure lengths greater than one millimeter for some fine hairs and average diameters greater than 50 μm for some others.

The appearance of the trichites formed on the TA6V4 alloy is very different. In this case, the surface of the oxyde is practically formed by the juxtaposition of many-angled small rods oriented at about 90° to the surface (Figures 7 and 8).

The various observations that we have just reported are currently the subject of a systematic study both morphologic and crystallographic. In this way, we hope to be able to obtain information on the growth mechanism of the trichites as well as on that of the underlaying layer.

Mr. F. Armanet (Physical-Chemical Analysis Service of the U.T.C.), assisted us during the use of the electron scan microscope.

(*) Session of 30 June 1975

(1) G. P. Lutschkin and G. G. Iljin, *Fisika Metallov i metallowedenie*, 2, 1956, p. 521

(²) K. Löhberg and H. W. Schleicher, *Z. Physik. Chem.*, 15, 1958, p.223

(³) F. Motte, C. Coddet, P. Sarrazin and J. Besson, *Ox. of Metals* (to be published).

C.C. :

Materials Laboratory

Mechanical Engineering Department

Compiègne University of Technology

60200 Compiègne, France;

F.M. and P.S.:

Laboratory on Adsorption and

Reaction of Gas on a Solid,

E.R.A. #368,

Advanced National School in

Electro-chemistry and Electro-metallurgy of Grenoble,

38000 Grenoble, France.

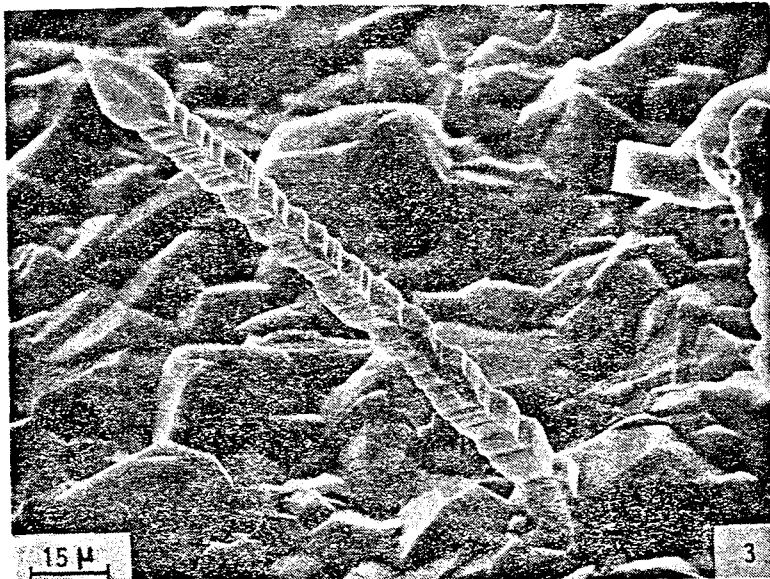


Figure 3 - Sample of Titanium Oxydized at 800°C for 100 hrs; $P_{H_2O} = 1.632$ Torr.

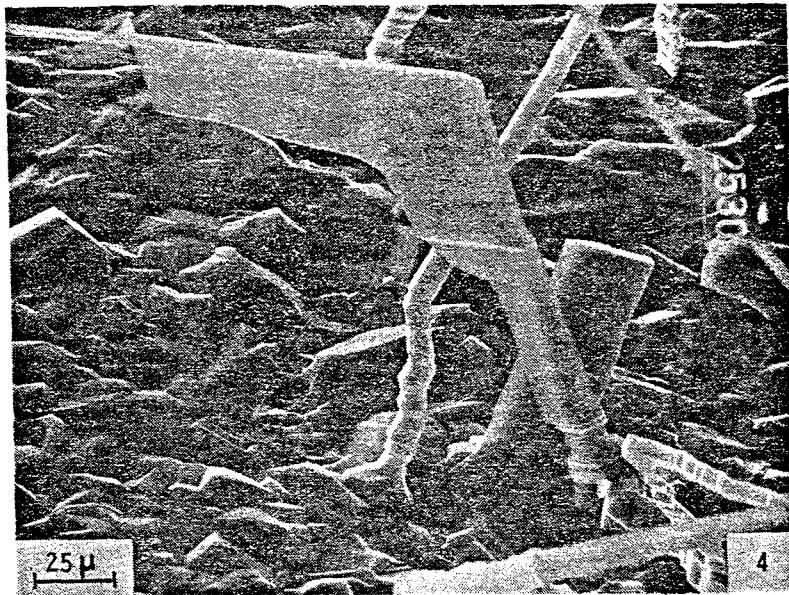


Figure 4 - Sample of Titanium Oxydized at 750°C for 100 hrs; $P_{\text{H}_2\text{O}} = 1.632 \text{ Torr.}$

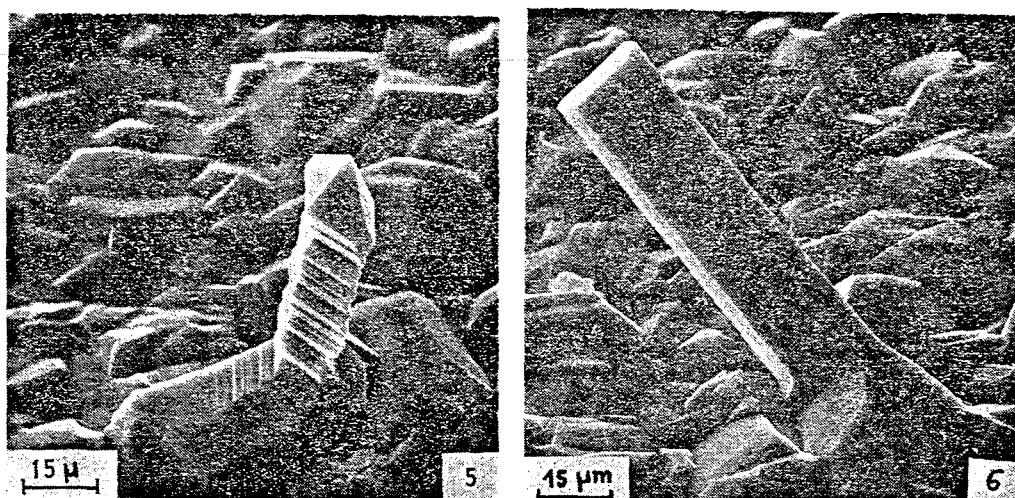


Figure 5 - Titanium Sample Oxydized at 800°C for 100 hrs; $P_{\text{H}_2\text{O}} = 1.632 \text{ Torr.}$

Figure 6 - Titanium Sample Oxydized at 800°C for 100 hrs; $P_{\text{H}_2\text{O}} = 1.632 \text{ Torr.}$

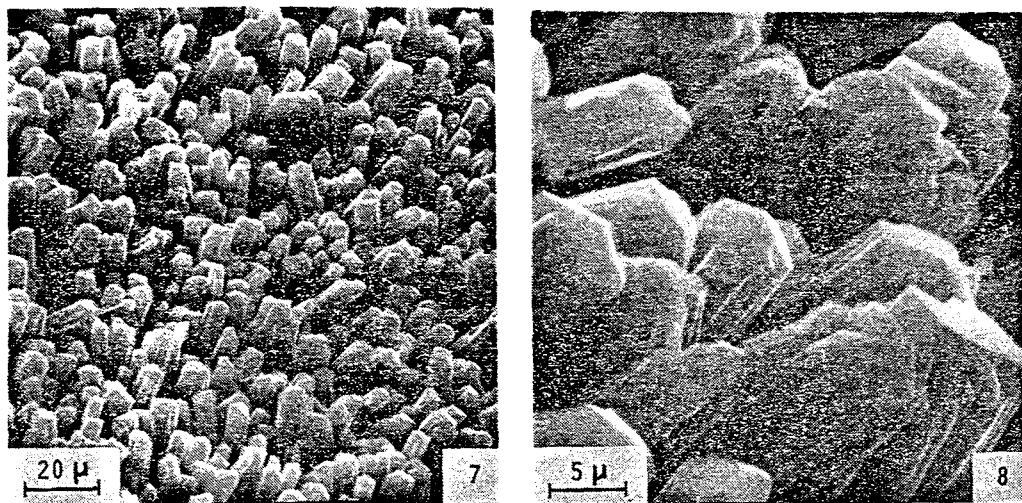


Figure 7 - TA6V4 Sample Oxydized at 750°C for 100 hrs; $P_{H_2O} = 1.632$ Torr.

Figure 8 - TA6V4 Sample Oxydized at 800°C for 100 hrs; $P_{H_2O} = 1.632$ Torr.

End of Document